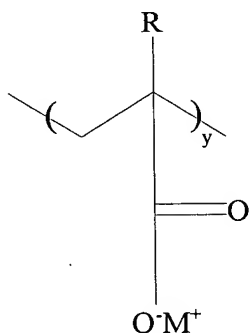


## CLAIMS

What is claimed is:

1. A coated substrate comprising:  
a substrate;  
5 a coating disposed on the substrate, wherein the coating comprises a self-assembled film having at least one bilayer, wherein each bilayer comprises a polyanion electrolyte layer and a polycation electrolyte layer, wherein an uppermost layer is a compound comprising a fluoroalkyl group; and  
wherein each bilayer thickness ranges from about 0.1 nanometers to about 20  
10 nanometers.
2. A coated substrate according to claim 1, wherein the substrate is an inorganic substrate selected from the group consisting of: silica glass, quartz glass, sapphire, ruby, spinel ceramic glass, yttrium silver, optical high-lead glass, cubic zirconia, a  
15 reflecting material, and a high index optical quality glass.
3. A coated substrate according to claim 1, wherein the substrate is silica glass.
4. A coated substrate according to claim 1, wherein the substrate is an organic  
20 substrate selected from the group consisting of: polyester, polycarbonate, polyacrylate, poly(methyl methacrylate), polyamide, and polystyrene.
5. A coated substrate according to claim 4, wherein the substrate is polycarbonate.  
25
6. A coated substrate according to claim 4, wherein the substrate is polyester.
7. A coated substrate according to claim 4, wherein the substrate is polyacrylate.
8. A coated substrate according to claim 1, wherein the substrate is an optical  
30 substrate.

9. A coated substrate according to claim 8, wherein the optical substrate is either transparent or reflecting.
10. A coated substrate according to claim 9, wherein the optical substrate is transparent.
11. A coated substrate according to claim 1, wherein the substrate has a shape selected from the group consisting of: curved, flat, cylindrical, conical, and spherical.
12. A coated substrate according to claim 11, wherein the substrate has a curved shape.
13. A coated substrate according to claim 11, wherein the substrate has a flat shape.
14. A coated substrate according to claim 1, wherein the polyanion electrolyte comprises a poly(acrylic acid) polyelectrolyte.
15. A coated substrate according to claim 14, wherein the poly(acrylic acid) polyelectrolyte has the structure:

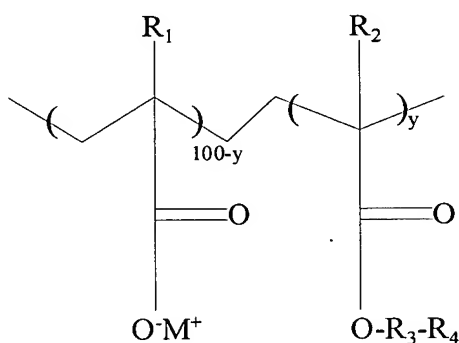


where:  $y = 1$  to 200,000;

M is selected from the group consisting of: H, Li, Na and K; and

R is selected from the group consisting of: hydrogen, methyl or ethyl.

16. A coated substrate according to claim 11, wherein the poly(acrylic acid)  
5 polyelectrolyte is a fluorocarbon-modified poly(acrylic acid) having the structure:



where:

y = 0.1 to 90 mole percent;

10 M is selected from the group consisting of: H, Li, Na, and K;

R<sub>1</sub> is selected from the group consisting of: H, CH<sub>3</sub>, and CH<sub>3</sub>CH<sub>2</sub>- ;

R<sub>2</sub> is selected from the group consisting of: H, CH<sub>3</sub>, and CH<sub>3</sub>CH<sub>2</sub>- ;

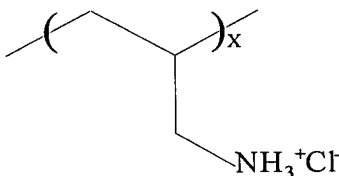
R<sub>3</sub> is selected from the group consisting of: (-CH<sub>2</sub>CH<sub>2</sub>O)<sub>x</sub> where x = 1 to 20;

R<sub>4</sub> is selected from the group consisting of: (-CF<sub>2</sub>)<sub>n</sub> CF<sub>3</sub> where n= 1 to 50.

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17. A coated substrate according to claim 1, wherein the polycation electrolyte  
comprises a poly(allylamine hydrochloride) polycation.

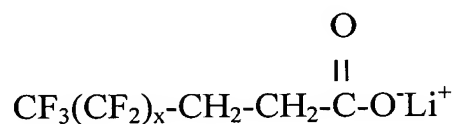
18. A coated substrate according to claim 17, wherein the poly(allylamine hydrochloride) polycation has the structure:



5 where  $x = 1$  to 200,000.

19. A coated substrate according to claim 1, wherein the fluoroalkyl group has the structure:

10



where  $x = 0$  to 50.

15

20. A coated substrate according to claim 1, wherein the polycation is a fluorinated polycation.

21. A coated substrate according to claim 1, wherein the polyanion is a fluorinated polyanion.

20

22. A coated substrate according to claim 1, wherein the coating comprises a plurality of bilayers and the coating has a thickness of about 0.1 nanometers to about 200 nanometers.

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23. A coated substrate according to claim 22, wherein the coating has a thickness of about 1 nanometer to about 10 nanometers.

24. A coated substrate according to claim 1, wherein the coating absorbs less than 1% of transmitted light between wavelengths of about 300 nanometers to about 3000 nanometers.

5 25. A coated substrate prepared by:

- a) providing a substrate;
- b) applying a first electrolyte layer to the substrate;
- c) applying a second electrolyte layer to the first electrolyte layer and allowing the second electrolyte layer to react with the first electrolyte layer to form a bilayer;
- 10 d) applying a compound comprising a fluoroalkyl group to the bilayer to form a coating on the substrate.

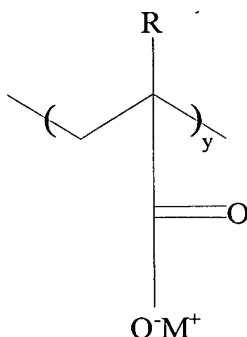
15 26. A coated substrate according to claim 25, wherein the steps of applying a second electrolyte layer to the first electrolyte layer are repeated a plurality of times to form a coating having a thickness ranging from about 0.1 nanometers to about 200 nanometers.

20 27. A coated substrate according to claim 25, wherein the first electrolyte layer is a polyanion electrolyte layer and wherein the second electrolyte layer is a polycation electrolyte layer.

25 28. A coated substrate according to claim 25, wherein the first electrolyte layer is a polycation electrolyte layer and the second electrolyte layer is a polyanion electrolyte layer.

29. A coated substrate according to claim 27, wherein the polyanion electrolyte layer comprises a poly(acrylic acid) polyelectrolyte.

30. A coated substrate according to claim 29, wherein the poly(acrylic acid) polyelectrolyte has the structure:

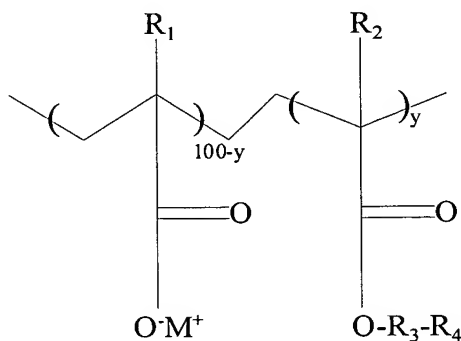


5 where  $y = 1$  to 200,000;

M is selected from the group consisting of: H, Li, Na and K; and

R is selected from the group consisting of: H,  $\text{CH}_3$ -, and  $\text{CH}_3\text{CH}_2$ -.

31. A coated substrate according to claim 29, wherein the poly(acrylic acid) polyelectrolyte is a fluorocarbon-modified poly(acrylic acid) having the structure:



where:

$y = 0.1$  to 90 mole percent;

15 M is selected from the group consisting of: H, Li, Na, and K;

$\text{R}_1$  is selected from the group consisting of: H,  $\text{CH}_3$ , and  $\text{CH}_3\text{CH}_2$ ;

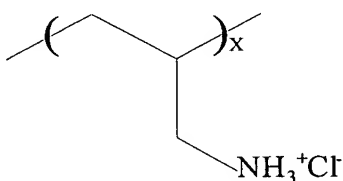
$R_2$  is selected from the group consisting of: H,  $CH_3$ , and  $CH_3CH_2-$  ;

$R_3$  is selected from the group consisting of:  $(-CH_2CH_2O)_x$  where  $x = 1$  to 20;

$R_4$  is selected from the group consisting of:  $(-CF_2)_n CF_3$  where  $n = 1$  to 50.

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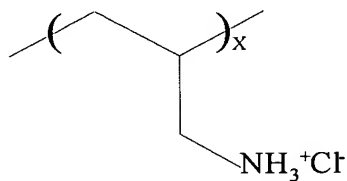
32. A coated substrate according to claim 27, wherein the polycation electrolyte layer is a poly(allylamine hydrochloride) polycation having the structure:



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where  $x = 1$  to 200,000.

33. A coated substrate according to claim 28, wherein the polycation electrolyte layer is a poly(allylamine hydrochloride) polycation having the structure:

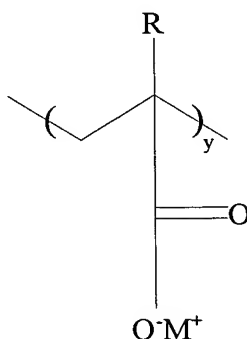


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where  $x = 1$  to 200,000.

34. A coated substrate according to claim 28, wherein the polyanion electrolyte layer comprises a poly(acrylic acid) polyelectrolyte.

35. A coated substrate according to claim 34, wherein the poly(acrylic acid) polyelectrolyte has the structure:

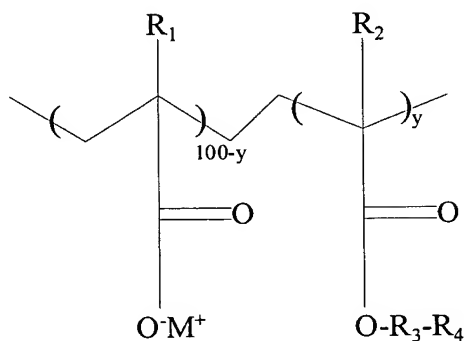


5 where:  $y = 1$  to 200,000;

M is selected from the group consisting of: H, Li, Na and K; and

R is selected from the group consisting of: H,  $\text{CH}_3$ -, and  $\text{CH}_3\text{CH}_2$ -.

10 36. A coated substrate according to claim 34, wherein the poly(acrylic acid) polyelectrolyte is a fluorocarbon-modified poly(acrylic acid) having the structure:



where:

$y = 0.1$  to 90 mole percent;

15 M is selected from the group consisting of: H, Li, Na, and K;

$\text{R}_1$  is selected from the group consisting of: H,  $\text{CH}_3$ -, and  $\text{CH}_3\text{CH}_2$ - ;



R<sub>3</sub> is selected from the group consisting of: (-CH<sub>2</sub>CH<sub>2</sub>O)<sub>x</sub> where x = 1 to 20;

R<sub>4</sub> is selected from the group consisting of:  $(-\text{CF}_2)_n \text{CF}_3$  where n= 1 to 50.

37. A coated substrate according to claim 25, wherein the compound containing the fluoroalkyl group has the structure:



where  $x = 0$  to 50.

38. A coated substrate according to claim 27, wherein the polyanion electrolyte layer comprises a fluorinated polyanion.

39. A coated substrate according to claim 27, wherein the polycation electrolyte layer comprises a fluorinated polycation.

20      40.      A coated substrate according to claim 39, wherein the polyanion electrolyte layer comprises a fluorinated polyanion.

41. A coated substrate according to claim 25, wherein the polyanion electrolyte layer comprises a fluorinated polyanion.

25

42. A coated substrate according to claim 25, wherein the polycation electrolyte layer comprises a fluorinated polycation.

43. A coated substrate according to claim 42, wherein the polyanion electrolyte layer comprises a fluorinated polyanion.